

The NASA SCI Files™
The Case of the Physical Fitness Challenge

Segment 2

Back at the tree house, RJ and Kali dial up Mr. Scott Smith at NASA Johnson Space Center in Houston, Texas, who explains how muscles and bones work together in the musculoskeletal system. He also makes clear the importance of nutrition and physical activity for the growth of healthy bones and explains why astronauts must continue to exercise in space to maintain bone health. Deciding that bones are an important part of being physically fit, RJ and Bianca check out the NASA SCI Files™ Kids' Club to learn more, and they dial up a classroom in Dundee, Scotland. Mr. David Shand's class at the Harris Academy has just finished conducting an experiment on how calcium loss affects bones. The detectives begin to realize that nutrition plays an important role in being physically fit and staying healthy. They decide to contact a doctor to learn more about nutrition. Bianca is on her way to Washington, D.C. and is able to get an appointment with Vice Admiral Richard H. Carmona, M.D., M.P.H., FACS, the U.S. Surgeon General! Vice Admiral Carmona explains what nutrients are and why they are important to good health. Meanwhile, back at Dr. D's lab, Dr. D explains that a calorie is a unit of measure that tells us the amount of energy stored in food and how our bodies combine oxygen with nutrients to produce energy. The detectives are sure they are on the right track but realize that there is much more to learn.

Objectives

Students will

- understand the role of bones in the body.
- learn how the design of bones makes them strong.
- examine a real bone.
- compare the amount of calcium needed by the body at different developmental stages.
- demonstrate the effect of calcium loss on bones.
- prove the importance of calcium in building and maintaining strong bones.
- calculate the amount of calcium consumed daily.
- determine which kinds of fruits contain the largest amount of vitamin C.
- identify the function of vitamins and minerals that are important to a healthy body.
- plan a nutritionally balanced snack.
- design a realistic nutrition label.
- explain how the small intestine works to break food into nutrients and to absorb them.

Vocabulary

bone marrow – soft tissue filling the spongy inside of bones; the purpose of bone marrow is to make new blood cells

calorie – a unit of measure that tells us the amount of energy stored in food

carbohydrates – a large group of compounds that includes sugars and starches, which are made naturally by plants and are one source of food energy (calories)

fat – an oily substance found in foods that is a source of energy (calories); excess fat is stored by the body and may cause health problems

ligaments – a strong band of white fibrous tissue that connects bones and cartilage

macronutrients – groups of nutrients, such as carbohydrates, proteins, and fats that provide energy and make up the bulk of the diet (nutrients required in small amounts are called micronutrients)

metabolism – all chemical processes of a living body; metabolism is influenced by exercise, food, and temperature

musculoskeletal system – network of bones and muscles that work together to move the entire body

nutrients – materials in foods that people need to grow and stay healthy

osteoporosis – a bone-thinning disease in which the levels of calcium in the body drop below what is needed, resulting in weakened bones and an increased risk of fractures or breaks

proteins – compounds that are very important for almost all parts of the body; also a source of food energy (calories)

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 2 of *The Case of the Physical Fitness Challenge*, discuss the previous segment to review the problem and reaffirm what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on the **Tools** section. The **Problem Board** is also in the **Problem-Solving Tools** section of the latest online investigation. Have students use it to sort the information learned so far.

2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have occurred during Segment 1. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 1.
5. Read the Overview for Segment 2 and have students add any questions to their lists that will help them better understand the problem.
6. **Focus Questions**—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to help them answer the questions. An icon will appear when the answer is near.

Video Component

7. **“What’s Up?” Questions**—These questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. They can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 of the Video

For optimal educational benefit, view *The Case of the Physical Fitness Challenge* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the “What’s Up?” Questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about nutrition and physical fitness.
4. Organize the information and determine whether any of the students’ questions from the previous segments were answered.
5. Decide what additional information is needed for the tree house detectives to determine the importance of bones and muscles on physical fitness and the role of nutrition in a healthy lifestyle. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
6. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
7. For related activities from previous programs, download the appropriate Educator Guide. On the NASA SCI Files™ home page, select the fence post that says “Guides.” Click on the **2002–2003 Season** tab and then click on *The Case of the Disappearing Dirt*©. In the green box, click on **Download the Educator Guide**.
 - a. In the **Educator Guide** you will find
 - a. Segment 1 – *There’s Iron in my Cereal*, page 26

Click on the **2004–2005 Season** tab and then click on *The Case of the Great Space Exploration*©. In the green box, click on **Download the Educator Guide**.

- b. In the **Educator Guide** you will find
 - b. Segment 2 – *Boney Bones*, page 35

8. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under **After Viewing** on page 15 and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, Problem-Based Learning activity:

Careers

dietician
 health teacher
 NASA researcher
 NASA scientist
 nurse
 occupational therapist
 physical therapist
 Surgeon General

Research Rack—books, internet sites, and research tools

Problem-Solving Tools—tools and strategies to help guide the problem-solving process

Dr. D’s Lab—interactive activities and simulations

Media Zone—interviews with experts from this segment

Expert’s Corner—listing of Ask-An-Expert sites and biographies of experts featured in the broadcast

9. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the **PBL Facilitator Prompting Questions** instructional tool found by selecting **Educators** on the web site.
10. Continue to assess the students’ learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. For more assessment ideas and tools, go to **Educators** and click on **Instructional Tools** in the menu bar.

Resources *(additional resources located on web site)*

Books

Lombardo, Michelle: *Organwise Guys – Learning to Be Smart from the Inside Out!* Wellness, Incorporated, 1996, ISBN: 096484382X.

Needham, Kate: *Why Do People Eat?* Usborne Books, 1993, ISBN: 0746013027.

Petrie, Kristin: *Vitamins Are Vital.* ABDO Publishing Company, 2003, ISBN: 1591974062.

Royston, Angela: *Vitamins and Minerals for a Healthy Body.* Heinemann Library, 2003, ISBN: 1403407584.

Royston, Angela: *Why Do Bones Break? and Other Questions about Bones and Muscles.* Heinemann Library, 2002, ISBN: 1403402019.

Showers, Paul: *What Happens to a Hamburger?* HarperCollins Publishers, 2001, ISBN: 0064451836.

Silverstein, Alvin and Silverstein, Virginia: *Eat Your Vegetables! Drink Your Milk!* Scholastic Library Publishing, 2000, ISBN: 0531165078.

Simon, Seymour: *Bones: Our Skeletal System.* HarperCollins Publishers, 2000, ISBN: 0688177212.

Video

NASA Center for Distance Learning: *NASA SCI-Files: The Case of the Biological Biosphere*© (2003)
Grades 3–5

Discovery Channel: *Bodies on the Mend* (2004)
Grades K–5

Discovery School: *An Inside Look at Broken Bones* (1997)
Grades 5–12

Educational Video Network: *What Are Nutrients?* (1996)
Grades 4–7

Eyewitness: *Skeleton* (1994)
Grades 4–8

Web Sites

Dundee, Scotland

Scotland's fourth largest city, Dundee, offers a warm welcome and a fascinating range of things to see and do.
<http://www.visitscotland.com/aboutscotland/cities/cityofdundee>

KidsHealth

This site has a wealth of information on topics such as staying healthy, the importance of eating healthy food, the new food guide pyramid, carbohydrates, proteins, vitamins, minerals, the importance of drinking water, the joys and benefits of physical activity, the human body, muscles, and body systems. All information is presented in a kid friendly format.
<http://www.kidshealth.org/kid/>

Calcium! Do You Get It?

On this U.S. Food and Drug Administration and Center for Food Safety and Applied Nutrition web site, learn about the importance of calcium to the body, including ways to increase your calcium. This site is aimed at girls ages 11–14.
<http://vm.cfsan.fda.gov/~dms/ca-toc.html>

National Institute of Child Health and Human Development

Play fun games on this kid friendly site to learn all about calcium and its benefit to the body.
<http://www.nichd.nih.gov/milk/kidsteens.cfm>

Calcium – Texas A&M University

Visit this interactive web site for a calcium adventure complete with a scavenger hunt of shopping, playing games, and gathering clues!
<http://calcium.tamu.edu/>

Powerful Bones. Powerful Girls. – The National Bone Health Campaign

This Center for Disease Control and Prevention web site is a kid-friendly, interactive site that educates girls about the benefits of staying healthy and getting enough calcium.
http://www.cdc.gov/powerfulbones/index_content.html

The Dairy Council of California

This web site is designed to assess the activity level of teenagers but can be used for anyone. NOTE: The site does ask for your name, age, and gender; however, the site claims to comply with the Children's Online Privacy Protection Act. It is recommended that you give only your first name. There is also a teachers' link for lesson plans and further information.

http://www.dairycouncilofca.org/activities/pfp/pfp_main.htm

Cabot Cheese

Visit this web site to learn more about calcium, the food pyramid, healthy bones, and nutrition in general. Find out about several free community programs such as a patch for Girl Scouts and scripts for the drama club.

<http://www.cabotcheese.com/>

Cabot Cheese—Ag in the Classroom

"Ag in the Classroom" is a free educational resource for grades K–8 that includes videos and a teacher guide. Challenge your students to learn about the power of persuasion, nutrition, and advertising and discover everything from how much a cow eats to fascinating careers in agriculture.

<http://www.cabotcheese.com/f1.tmpl?left=menu-education.html&right=EdAndFun.html>

Cabot Cheese—Calcium Crisis Challenge

Teachers may register their schools to take the Cabot Calcium Crisis Challenge. Rules for the challenge, necessary forms, including judging sheets, and media advisory letters are included. Students will complete research and prepare presentations to help educate others about the importance of calcium. An extensive collection of resources about calcium is listed at the bottom of the page and may be reached without registering for the challenge by simply scrolling down and clicking on the resources link.

<http://www.cabotcalciumchallenge.com/>

State of Missouri: Governor's Council on Physical Fitness and Health

Take a virtual tour of the human body and complete activities to learn more about the body and its parts.

<http://www.mofitness.org/BodyWalk/>

Human Adaptation and Countermeasure Office

Visit this kid-friendly NASA Johnson Space Center web site to learn more about nutrition and the human body. Download Space Nutrition newsletters that contain fun facts, experiments, and web challenges to learn about topics, such as vitamin D, the solar powered vitamin, rats and vitamin K, and what happens when our bodies oxidize.

<http://haco.jsc.nasa.gov/biomedical/nutrition/newsletter.shtml>

United States Department of Health and Human Services

Go to this site to learn about America's chief health educator, the Surgeon General, who gives Americans the best scientific information available on how to improve health and reduce the risk of illness and injury.

<http://www.surgeongeneral.gov/>

United States Food and Drug Administration (USDA)

Visit this web site to learn about the job of the USDA. Read about recent Food and Drug Administration news and how they regulate food and drugs in our country to keep Americans safe.

<http://www.fda.gov/>

Cool Food Planet

Explore this kid-centered web site to learn about health and nutrition. Enjoy informative activities and quizzes as you learn about ways to stay healthy.

<http://www.coolfoodplanet.org/gb/kidz/>

Nutrition Explorations

This site has activities and information for educators, parents, and kids. There are lots of games and activities to help you learn about nutrition.

<http://www.nutritionexplorations.org/>

Nutrition Café

Learn all about nutrition through fun and interactive games sponsored by the Pacific Science Center and the Washington State Dairy Council. Evaluate the healthiness of a meal or help the nutrition detective find the missing nutrients.

http://exhibits.pacsci.org/nutrition/nutrition_cafe.html

How Stuff Works

Travel to this web site to learn about vitamins and how they work.

<http://www.howstuffworks.com/question129.htm>

Activities and Worksheets

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	Bendy Bones	
	Conduct this simple experiment to see what happens to your bones over time when calcium is removed.	47
	Counting the Calcium	
	Find out if you are getting enough calcium in your diet by using this simple calcium calculator.	49
	Oh, Say Can You C?	
	Conduct a test to determine which kinds of fruit contain the most vitamin C.	52
	Rate That Snack	
	Learn about the importance of healthy snacks while creating your own nutritionally balanced snack and designing a package that teaches others about nutrition.	54
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On the Web	Being on the Inside	
	Find out how your body uses the digestive process to remove vitamins and minerals from the foods we eat.	

Putting on the Bone*

Segment 2

Purpose

- To understand the role of bones in the body
- To learn how the design of bones makes them strong
- To examine a real bone

Teacher Prep

Cook the chicken bones ahead of time and remove all meat. Soak bones for 5 minutes in a 1:10 bleach/water solution. Cut or break half the bones into two pieces and leave the other half whole.

Background

Bones not only give the body support and protection, they are also light enough to make moving your body easy. Although bones look solid from the outside, they are not. If they were completely solid, they would be too heavy and hard to move. Bones are made of different layers. The hard, outer layer is made of living cells. Minerals such as calcium and phosphorus surround the cells, giving the bones their strength. A thick membrane of soft tissue that protects the hard outer layer covers the bones inside your body. This membrane helps heal damaged bone tissue. Underneath the hard outer layer of bone is a spongy layer. The spongy layer is hard as well but is called spongy because it has an open structure filled with tiny holes. Bone centers have a hollow cavity. The cavity contains a special tissue called bone marrow. Blood vessels run through the marrow, carrying food and oxygen to the bone cells and taking away waste. Bones contain two types of marrow. Red marrow produces blood cells and yellow marrow is made of fatty tissue cells that can convert to energy when your body runs low on fuel. Bone marrow looks similar to thick jelly.

Procedure

Part 1

- Using clay, build a clay person about 15–30 cm tall.
- Without sticking the clay to a hard surface, try to get the clay person to stand unaided.
- Release the clay person and observe. Record your observations in your science journal.
- Rebuild your clay person, this time using toothpicks inside the clay to represent the bones in the body. See diagram 1.
- Repeat steps 2 and 3.
- On the sheet of cardboard, use a ruler to find and mark the center point. Make the mark very dark. See diagram 2.
- Place an empty cup right side up on a flat surface. This cup will represent a hollow bone. See diagram 3 on page 42.
- Place the cardboard on top of the cup with the center mark over the center of the cup.
- Predict how many books can be stacked on top of the cup before it collapses. Record your prediction on the Weight Chart Worksheet.
- Estimate the weight of the books and enter in the chart the estimated predicted amount of weight the cup can support.
- Begin stacking the hardback books on the cup, one at a time. Make sure to center them over the center mark on the cardboard.
- Keep stacking books until the cup collapses.
- On the Weight Chart Worksheet, record the number of books it took to collapse the cup.
- Use the bathroom scale to weigh the books. Record the weight in pounds on the Weight Chart Worksheet.
- Repeat the experiment (steps 7–14) two more times.

Materials

(Per Group)

- 2 150 mL (5 oz) nonreinforced paper cups
- 6–10 heavy hardback books
- dried beans
- large sheet of corrugated cardboard
- metric ruler
- marker
- clay
- toothpicks
- science journal
- bathroom scale
- 2 long chicken leg or thigh bones

(Per Student)

- Weight Chart Worksheet
- safety goggles
- gloves
- magnifying glass
- paper plates

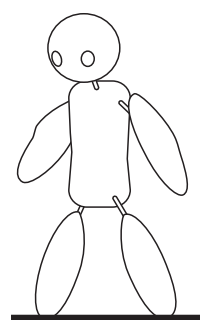


Diagram 1

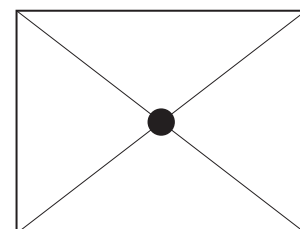


Diagram 2

Putting on the Bone*

16. Calculate the average amount of weight the cup held. To calculate, add the three weights and divide the total by three.
17. Fill one cup completely with the dried beans. This cup will represent a solid bone filled with the spongy hard layer.
18. Place the filled cup on a flat surface.
19. Repeat steps 8–17.
20. In your science journal, record your observations and describe what you learned during the experiment.

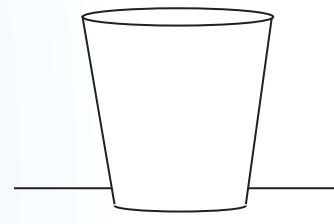


Diagram 3

Part 2

21. Put on safety goggles and gloves.
22. Place a whole chicken bone on a paper plate.
23. Examine the chicken bone by using your eyes only.
24. In your science journal, illustrate the bone.
25. Examine the chicken bone with the magnifying glass.
26. In your science journal, illustrate the bone under magnification.
27. Discuss and predict what the inside of the bone will look like.
28. Draw your prediction in your science journal.
29. Place a chicken bone that has been cut in half on a paper plate.
30. Repeat steps 23–26.
31. Properly dispose of the gloves.
32. Immediately wash hands thoroughly with soap and water.

Discussion

1. Describe the difference between the clay person without “bones” and the clay person with “bones.”
2. Why do you think the skeleton is important to the human body?
3. Which cup held the most weight? Why do you think it was able to hold more weight?
4. Which cup is most like the bones in your body? Why?
5. What did you observe when you examined the chicken bones? How did the inside of the actual bone compare to your prediction?

Extension

1. Examine a sponge with your eyes and with a magnifying glass. How is a sponge similar to the inside of a bone? How is it different? Fill one of the cups with cut up pieces of sponge. Stack the books on top of the cup. How many books was this “bone” able to hold?
2. Obtain X-rays from a local physician or hospital. Look at the pictures. What can you tell about the bones from the X-rays? Conduct research to learn more about X-rays.
3. Tape flat objects such as leaves, coins, or washers to the bottom of a sheet of paper. Overlap the items. Turn the paper over and use a pencil or crayon to make a rubbing of the items. Carefully remove the items from the back of the paper. Show the rubbing to someone else and have them guess which items you used to make the drawing. Explain how this picture is similar to an X-ray.

* This hands-on activity was adapted from activities in *From Outer Space to Inner Space/Muscles and Bones: Activities Guide for Teachers* created by Baylor College of Medicine for the National Space Biomedical Research Institute under NASA Cooperative Agreement NCC 9-58. The activities are used with permission of Baylor. All rights reserved.

For additional activities visit http://www.nsbri.org/Education/Elem_Act.html

Putting on the Bone*

Segment 2

WEIGHT CHART WORKSHEET

	Prediction for Number of Books Supported	Actual Number of Books Supported	Prediction for Weight Supported	Actual Weight of Books Supported
Hollow Bone				
Trial 1				
Trial 2				
Trial 3				
Average				
Solid Bone				
Trial 1				
Trial 2				
Trial 3				
Average				

Hole-y Bones

Segment 2

Purpose

To compare the amount of calcium needed by the body at different developmental stages
To demonstrate the effect of calcium loss on bones

Background

Calcium is an important mineral that helps build and maintain strong bones and teeth. If calcium were removed from the body, it would resemble flour. The amount of calcium in your body will change throughout your life. Newborn babies have only about 30 grams of calcium. By age 10, the amount of calcium has increased to nearly 420 grams. As the bones continue to grow, the amount of calcium in the body continues to increase. By age 15, the amount of calcium will have doubled from that of a 10 year old to 840 grams. By the time children reach adulthood, the bones will contain 44 times as much calcium as they did when they were born, or nearly 1,320 grams. Physical activity also helps build strong bones. The good stress on the bones created from physical activity is particularly important during the bone growing years. After age 25, the bones stop growing and are as big as they will ever be. But the needs for calcium and physical activity do not stop. Bones lose about 1% of the total amount of calcium in the body each day. Because calcium is absorbed by the body in small quantities, it is important to take in additional amounts of calcium throughout the day. When the body does not get enough calcium, bones have a higher risk of fracture or breaking. Osteoporosis is a disease in which levels of calcium in the body drop so much that the bones begin to thin and weaken. Osteoporosis in adults cannot be detected until the bone loss is between 30 and 40%, making the bones very fragile. Astronauts who spend more than 180 days in space lose about 20% of their bone mass. Getting the recommended daily amount of calcium and being physically active will help keep bones healthy throughout life.

Procedure

Part 1

- Using the scale, measure 30 g of flour.
- Pour the flour into a zippered bag. Be sure to seal it completely.
- Using the marker, label the bag "Newborn Child – 30g" and record in the Bone Data worksheet.
- Measure 420 g of flour and put it into a bag.
- Label the bag "Age 10 – 420 g" and record.
- Measure 840 g of flour and put it into a bag.
- Label the bag "Age 15 – 840 g" and record.
- Measure 1,320 g of flour and put it into a bag.
- Label the bag "Adult – 1,320 g" and record. See diagram 1.
- To calculate the calcium of an adult suffering from osteoporosis
 - Multiply 1,320 times 40%
 - Subtract your answer from 1,320
 - Record the answer in the Bone Data Worksheet.
 - Round your answer to the nearest whole number and record.
- Measure this amount of flour and put it into a zippered bag.
- Label the bag "Adult with osteoporosis – ____ g."
- To calculate how much calcium an astronaut loses after being in space for a long period of time
 - Astronauts lose about 20% of their bone mass while in space
 - Multiply 1,320 times 20%

Materials

2 bags of flour
(approximately 5 kilograms)
scale to measure grams
6 large, zippered plastic bags
marker
science journal
copy paper
scissors
pencil
single hole-punch
Bone Data Worksheet
(p. 46)
calculator (optional)

zipper bag

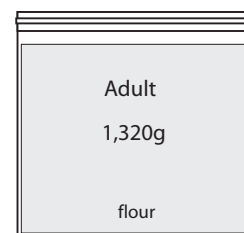
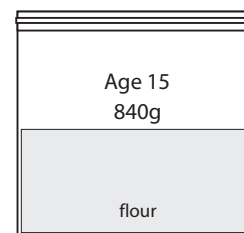
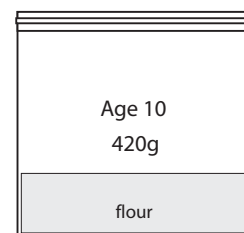
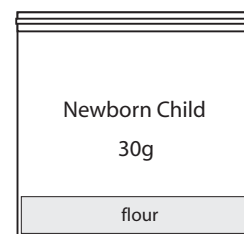


Diagram 1

Hole-y Bones

Segment 2

- c. Subtract the answer from 1,320.
- d. Record the answer in the Bone Data Worksheet
- e. Round your answer to the nearest whole number and record
14. Measure this amount of flour and put it into a zippered bag.
15. Label the bag, "Astronaut on long-duration space flight-- ____ g."
16. Look at the data in the Bone Data Worksheet. Compare the amount of flour in each bag. How do they compare?
17. To calculate how much calcium your body loses per year at each stage, take each measurement and multiply it by .01 (1%).
18. Record the answers in the Bone Data Worksheet.
19. Round the answers to the nearest whole number and record in the Bone Data Worksheet.

Part 2

20. Stack three sheets of paper together and fold them in half, lengthwise.
21. Keeping the papers folded, draw a tibia (lower leg bone) or femur bone (upper leg bone) on the top paper, filling the half sheet. See diagram 2.
22. Keeping the papers folded so that the bone you drew is on top, cut through all sheets to create six bones that are exactly the same.
23. Choose one bone to be the control bone and firmly grasp each end of the paper bone with both hands. See diagram 3.
24. Tug on both ends of the bone, creating stress in the center of the paper bone.
25. Count each tug and continue to tug until the paper bone breaks. If it doesn't break, stop after 40 tugs and record 40+ tugs.
26. Record the number of tugs in the Bone Data Worksheet.
27. Select a second paper bone to represent the bone of a 10 year old.
28. Looking at your bone loss chart, find the amount of calcium loss, rounded to the nearest whole number for a 10 year old.
29. Use a hole-punch to punch that number of holes in the center, long shaft of the bone. See diagram 4.
30. Tug on the bone, as before, being sure to count each tug.
31. Record how many tugs it took to break the bone on the Bone Data Worksheet.
32. Repeat for each of the remaining categories: 15-year old, adult, adult with osteoporosis, and astronaut. Make sure to punch the number of holes in the paper bone that corresponds to the grams of calcium lost.
33. Record your findings for each bone.

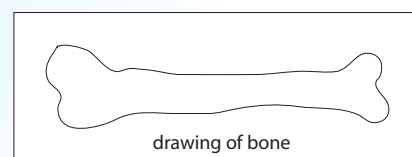


Diagram 2

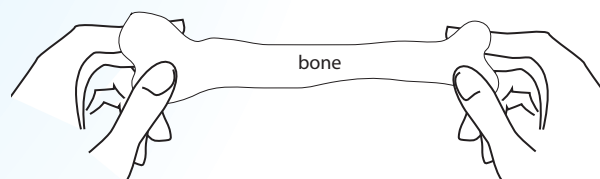


Diagram 3

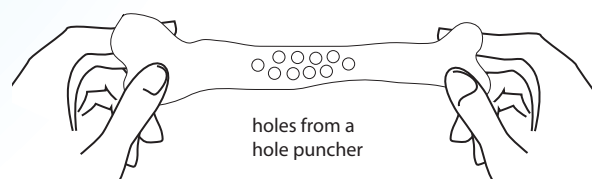


Diagram 4

Discussion

1. Why is calcium important to bones?
2. What happens to bone strength as bone mass is lost?
3. How much calcium is recommended for someone your age?
4. What can you do to prevent bone loss?

Hole-y Bones

Segment 2

Extension

1. A smoothie is a delicious, nutritious snack that is also a great source of calcium. A basic smoothie contains 118 mL (1/2 cup) to 177mL (3/4 cup) milk, 59 mL (1/4 cup) to 118 mL (1/2 cup) frozen yogurt or ice cream, and any combination of fruits, cinnamon, cocoa, chocolate syrup, oatmeal, vanilla extract, honey, peanut butter, and juice concentrates. With adult supervision, blend these ingredients or others you like to create your own smoothie.
2. Research to find the amount of calcium in your smoothie. Create a nutrition label for your smoothie. Produce an ad to promote it.
3. In class, have each group create a unique smoothie. Share a small amount with other classmates. Rate each group's smoothie for taste and calcium value.
4. Conduct research to learn what the recommended daily allowance is for calcium during each stage of development.
5. Research to find which foods are rich in calcium.
6. Keep a chart that shows how many foods you are eating that are good sources of calcium.

BONE DATA WORKSHEET

Age	Grams	Calcium loss (in grams)	Calcium loss (in grams rounded to nearest whole number)
Newborn			
10			
15			
Adult			
Adult with Osteoporosis			
Astronaut on long-duration flight			

Bone	Number of holes punched (each hole = 1 gram of calcium)	Number of tugs to break bone
1 – Healthy Bone (control)	- 0 -	
2 – 10 year old		
3 – 15 year old		
4 – adult		
5 – adult with osteoporosis		

Bendy Bones

Segment 2

Purpose

To prove the importance of calcium in building and maintaining strong bones

Background

Our bones get their strength from a hard outer covering that contains the mineral calcium carbonate. The calcium keeps the bones stiff and rigid. The human body needs calcium for building healthy teeth and bones. Without this mineral, our bones would be soft and flexible. Because teeth and bones grow the most during childhood and adolescence, it is especially important for kids to get enough calcium. The more bone mass children can accumulate during these years, the less likely they are to develop serious bone problems in the future. Bones lose calcium over time, so the calcium must be replaced daily. Children, ages 4–8, need 800 mg of calcium per day, while those ages 9–18 need 1,300 mg per day. Consistent low levels of calcium can cause health problems, including the increased likelihood of broken bones, unhealthy teeth and gums, and rickets. As an adult, these low levels can cause osteoporosis, a painful condition caused by a decrease in bone density that often leads to broken hips and other fractures in the elderly. Eating a well balanced diet that includes foods rich in calcium is an important way to keep bones healthy. In this activity, vinegar, an acid, will slowly dissolve the calcium in the bones, making the bones weak.

NOTE: This experiment will take place over 3 weeks.

Materials

4 similarly cooked
chicken bones (with all
meat removed)
vinegar (approximately
1.5 liters (L))
4 jars with tight sealing
lids
safety goggles
gloves
water
protractor
permanent marker
access to a sink
Bendy Bones
Worksheet p. 48

Procedure

1. Wear your safety goggles and gloves whenever you are performing this activity.
2. Place one chicken bone in each of the four jars.
3. Label the first jar "control."
4. Label the second jar "Vinegar – 1 Week."
5. Label the third jar "Vinegar – 2 Weeks."
6. Label the fourth jar "Vinegar – 3 Weeks."
7. To the "control" jar, add water to completely cover the bone.
8. To the other three jars, add vinegar to completely cover the bones.
9. Put the lids on all four jars and tighten them securely.
10. Place the jars in a safe place. Dispose of gloves properly.
11. After one week, get the "Control" and "Vinegar – 1 Week" jars.
12. Put on your safety goggles and gloves.
13. Remove the bone from the "Control" jar.
14. Rinse the bone off with water from the sink.
15. Try to bend the bone.
16. Use a protractor to measure how much the bone bends with reasonable force. See diagram 1.
17. Record your results on the Bendy Bones Worksheet.
18. Remove the bone from the "Vinegar – 1-Week" jar.
19. Repeat steps 14–17.
20. Put the control bone back in the control jar, tighten the lid, and return the jar to a safe place.
21. Properly dispose of the gloves and contents of the vinegar jar. NOTE: Jars MUST be sanitized before reusing.
22. After the second week, get the "Control" and "Vinegar – 2-Weeks" jars.

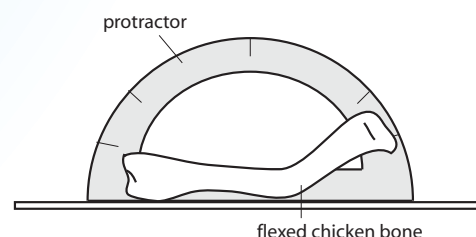


Diagram 1

Bendy Bones

23. Put on your safety goggles and gloves.
24. Repeat steps 13–17.
25. Remove the bone from the “Vinegar – 2-Weeks” jar.
26. Repeat steps 14–17.
27. Put the control bone back in the control jar and return it to a safe place.
28. Properly dispose of the gloves and contents of the vinegar jar and sanitize jar before reusing.
29. After 1 more week, get the “Control” and “Vinegar – 3 Weeks” jars.
30. Put on your safety goggles and gloves.
31. Repeat steps 13–17.
32. Remove the bone from the “Vinegar – 3 Weeks” jar.
33. Repeat steps 14–17.
34. Properly dispose of the gloves and contents of the control and vinegar jars and sanitize jars before reusing.

Discussion

1. Which bone was the strongest? Weakest? How do you know?
2. What effect does the vinegar have on the calcium in the bones?
3. As the amount of calcium in a bone decreases, what happens to the bone? How do you know?
4. What are some of the long-term effects of calcium loss?

Extensions

1. Repeat the activity again to see if you get the same results. How did your results from the two trials compare? Why is it important for scientists to do more than one trial?
2. Ask a local dentist for fluoride. Get two eggs, two jars with tight lids, vinegar, and a paintbrush. Put on your safety goggles and gloves. Fill one jar with vinegar and place an egg in it. Seal the lid tightly and label this jar “control.” Fill the other jar with vinegar. Using the paintbrush, coat the outside of the other egg with fluoride. Place the egg in the vinegar. Seal the lid tightly on the jar and label it “fluoride.” Wait 2–3 days and check the eggs. Remember to wear your safety goggles and gloves. What do you notice about the two eggs? Put the eggs back into the proper jars and allow more time to pass to see if any additional changes occur. Why is fluoride important to keeping teeth healthy?

BENDY BONES WORKSHEET

Bone In:	Degrees Bones Bend After 1 Week	Degrees Bones Bend After 2 Weeks	Degrees Bones Bend After 3 Weeks
Water (control)			
Vinegar			

Counting the Calcium*

Segment 2

Purpose

To calculate the amount of calcium in your diet

Background

Calcium is necessary to build strong bones and teeth, regulate the heartbeat, clot the blood, maintain proper thyroid function, and help transmit nerve impulses. Calcium is the most abundant mineral in the human body. The teeth and bones contain 99% of the body's calcium. Because new bone is constantly being formed and broken down, the body needs a regular calcium supply. Peak bone growth occurs between the ages of 12 and 25. Getting the recommended daily amount of calcium is critical during these growing years, but the body never outgrows its need for calcium.

Osteoporosis is a disease in which bones become weak and fragile. Because the bones are not as strong, they are more likely to break. These breaks, or fractures, usually occur in the hips, spine, and wrists. Often these breaks are very painful and do not heal fully. Getting the daily recommended amount of calcium early in life can help prevent the development of osteoporosis. Unfortunately, the National Health Institute reports that only 19% of teenage girls and 52% of teenage boys are getting the recommended amounts of calcium per day.

Vitamin D is also important to healthy bone growth. Vitamin D helps the body absorb the calcium that is consumed. Milks and cereals (and some orange juice) are fortified with vitamin D. A fortified food is one that has had nutrients added to it. Although some foods contain vitamin D, most of the vitamin is made in your skin when you are exposed to sunlight. Once vitamin D is produced in the skin or consumed in food, it requires chemical change in the liver and kidney to form its active hormone form. Active vitamin D functions as a hormone because it sends a message to the intestines to increase the absorption of calcium. If you don't get enough vitamin D, your body is deficient in the vitamin and will not be able to use the calcium from food to build strong bones and teeth.

In space, astronauts may lose 20% of the calcium in their bones on long-duration space flights. Because the shuttle and the International Space Station are shielded to prevent crewmembers from being exposed to the Sun's rays, the crewmembers must consume vitamin D during space flight and eat foods that replace the lost calcium.

Procedure

1. For one day, keep a log of all the foods you eat and their portion sizes. Be sure to also include drinks in your log.
2. Use the Calcium Calculator Worksheet to identify any calcium-rich foods noted in your log.
3. Estimate the number of portions you ate for each food.
4. Total the number of portions in each category.
5. Multiply this number by the milligrams of calcium per serving.
6. Enter this amount in the box in the far right column.
7. Total the amounts in the boxes.
8. Record your calcium intake and your recommended daily allowance of calcium.
9. Compare your calcium intake to your calcium need.

Discussion

1. Why is calcium important to the body?
2. What are some common calcium-rich foods?
3. What role does vitamin D play in healthy bone development?
4. From what two sources do we get vitamin D?
5. What can you do to add more calcium to your diet?

Materials

Calcium Calculator
Worksheets (p. 51)
pen or pencil
science journal
calculator (optional)
computer with Internet access

Counting the Calcium*

Segment 2

Extensions

1. In this activity the amount of calcium in each food is an estimate, rounded for easy calculation. To find a more exact estimate of your calcium intake, conduct an Internet search for an online calcium calculator. Many dairy council sites include kid friendly calculators.
2. Design a series of daily menus that feature calcium-rich foods. Be sure to include some healthy calcium-rich snacks.
3. Launch a public service campaign to help make people aware of the need for calcium. You might write a commercial for your school announcements or make posters to hang in the school cafeteria. Contact your public broadcasting station or local radio station to see if they will allow you to put your announcement on the air.

* This hands-on activity was adapted from activities in *From Outer Space to Inner Space/Muscles and Bones: Activities Guide for Teachers* created by Baylor College of Medicine for the National Space Biomedical Research Institute under NASA Cooperative Agreement NCC 9-58. The activities are used with permission of Baylor. All rights reserved. For additional activities visit http://www.nsbri.org/Education/Elem_Act.html

Counting the Calcium*

Calcium Calculator

CALCIUM CALCULATOR WORKSHEET

Check your food log and identify any calcium rich foods you ate from the Daily Calcium Needs table. Estimate the number of portions for each food you checked in the table. Total the number of portions and multiply by the milligrams of calcium per serving. Put the total in the box at the far right and then add the amounts in these boxes. This final total is your estimated calcium intake.

Daily Calcium Needs

Age:	1–3 years	500 mg	4–8 years	800 mg
	9–18 years	1300 mg	19–50 years	1000 mg *
	51 + years	1200 mg		

NOTE: The Recommended Daily Allowance is based on the amount of calcium needed for this age group. If you are younger or older, you may need to revise the amount of calcium in your diet.

Calcium-rich Foods	Portion Size	# of portions yesterday	mg of Calcium per portion	Total mg of Calcium
___ Bagel	1	___		
___ Bread	2 slices	___		
___ Broccoli, cooked	¾ cup	___		
___ Beans (Kidney, Lima)	1 cup	___		
___ Corn tortilla	1	___		
___ Kale, cooked	½ cup	___		
___ Lentils	1 cup	___		
___ Orange (fruit, not juice)	1 med.	___		
	Total	___	x 50 mg	= mg
___ Bok choy	½ cup	___		
___ Chickpeas	1 cup	___		
___ Cottage cheese	½ cup	___		
___ Ice Cream	½ cup	___		
___ Parmesan cheese	1 Tbsp	___		
___ Almonds	¼ cup	___		
___ Eggs	2 whole	___		
	Total	___	x 75 mg	= mg
___ Baked beans	1 cup	___		
___ Cheese pizza	1 slice	___		
___ Ice milk, Frozen yogurt	½ cup	___		
___ Pancakes, Waffles		___		
<i>(made with milk)</i>	3 med.	___		
___ Pudding <i>(with milk)</i>	½ cup	___		
___ Soft and semi-soft cheeses		___		
<i>(such as mozzarella)</i>	1 ¼" cube	___		
___ Soup made with milk	1 cup	___		
___ Calcium enriched Cereal	1 cup	___		
	Total	___	x 150 mg	= mg
___ American cheese	2 slices	___		
___ Firm cheeses	1 ¼" cube	___		
<i>(such as cheddar, Swiss)</i>		___		
___ Processed cheese	2 slices	___		
___ Salmon, canned	½ can	___		
with bones		___		
___ Sardines, canned	½ can	___		
with bones		___		
___ Yogurt, fruit flavored	¾ cup	___		
___ Macaroni and cheese	1 cup	___		
	Total	___	x 250 mg	= mg
___ Milk, skim, 1%, 2%	1 cup	___		
___ Whole, buttermilk, or chocolate		___		
___ Calcium-fortified beverages, e.g., soy, rice milk	1 cup	___		
___ Orange juice with added calcium	1 cup	___		
___ Ricotta cheese	½ cup	___		
___ Skim milk powder	1/3 cup	___		
___ Tofu	½ cup	___		
___ Yogurt, plain	3/4 cup	___		
	Total	___	x 300 mg	= mg

My calcium intake _____
My recommended intake _____
The difference _____

Oh, Say Can You C?

Purpose

To determine which fruits contain the largest amounts of vitamin C

Background

Vitamins are important nutrients the body needs for healthy growth and development. They are removed from the foods we eat during a process called digestion. Different foods contain different vitamins, so a balanced diet with a variety of different foods is the key to good nutrition.

There are two types of vitamins: fat-soluble and water-soluble. Fat-soluble vitamins are vitamins that are stored in the fat tissues in the body and in the liver, where they remain until the body needs to use them. Some fat-soluble vitamins are stored for as little as a few days, while others can be stored for as long as six months. These vitamins should only be consumed in moderation. Exceeding the daily-recommended value of fat-soluble vitamins can be harmful to your health. Vitamins A, D, E, and K are all fat-soluble vitamins. Water-soluble vitamins are not stored in the body, but travel through the bloodstream. Whatever the body does not need passes out of the body in urine.

Vitamin C, also known as ascorbic acid, is a water-soluble vitamin that must be replaced often. Vitamin C is needed for growth and repair of body tissues and to help the body heal from injuries and infections. Vitamin C deficiency, caused by not eating enough foods containing vitamin C, may result in joint stiffness, nose bleeds, dry hair and skin, gingivitis (swelling of the gums), and extreme physical weakness. Vitamin C is an anti-oxidant as well. Antioxidants are nutrients that help prevent damage caused by oxidation. Oxidation is a chemical reaction that damages cell structure. Oxidation in our bodies can cause health problems such as cancer or heart disease. Natural foods that are very colorful are usually good sources of antioxidants. Green vegetables and citrus fruits are good sources of vitamin C.

The presence of vitamin C in foods can be detected using a cornstarch-iodine solution. When a liquid containing vitamin C is added to the solution, a color change occurs. This process is known as titration. The fewer drops required to change the color of the solution, the greater the amount of vitamin C.

*Note: Iodine may stain when it comes into contact with the skin. There may be some reactions associated with iodine. Please refer to a Material Safety Data Sheet (MSDS) that can be found online at sites such as: <http://www.delasco.com/pcat/pdf/starchio.pdf>

Teacher Prep

Cornstarch-iodine solution: 500 mL container; cornstarch; water; tincture of iodine; spoon; coffee filters; small, clear glass containers (three for each group or student); and eyedropper

CAUTION: An adult must prepare this solution.

1. Fill the 500-mL container with water.
2. Mix 30 mL (2 tablespoons (tbsp) of cornstarch into the water.
3. Stir thoroughly.
4. Filter the starch solution through several coffee filters until the solution is clear.
5. Using an eyedropper, add the tincture of iodine by drops, stirring constantly with the spoon. Keep adding drops until the solution turns a deep, dark blue. (If the solution turns brown, you have added too much iodine.)
6. Pour 10 mL of this solution into each clear glass container.

Materials

3 different fruits (avoid red or purple fruits)
eyedropper
white construction paper
3 small cups or bowls
Vitamin C Data Chart (p. 53)
safety goggles
gloves
pen or marker
graph paper
colored pencils
materials prepared by the teacher

Oh, Say Can You C?

Segment 2

Procedure

1. Put on safety goggles and gloves.
2. Observe the three glass containers with the cornstarch-iodine solution and record your observations in your science journal.
3. Squeeze one fruit in a small cup or bowl so that it produces juice.
4. Hold a piece of white construction paper behind one container of the cornstarch-iodine solution.
5. Using an eyedropper, put the juice squeezed from the fruit into the solution, one drop at a time. Count each drop of juice as you add it. See diagram 1.
6. Carefully swirl the liquid in the container after each drop.
7. Continue adding the juice until the solution appears colorless against the white background paper.
8. Record the number of drops of juice you added to the cornstarch-iodine solution on the Vitamin C Data Chart.
9. Empty the container and rinse.
10. Using a different type of fruit, repeat steps 3–9.
11. Repeat steps 3–9 with the last fruit sample.
12. Create a graph to show the various levels of vitamin C in the different types of juice tested based on the number of drops you used for each.

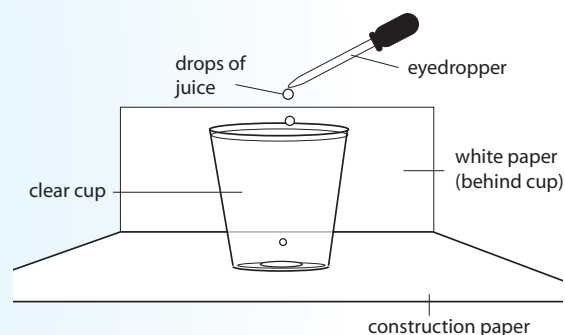


Diagram 1

Discussion

1. What is the relationship between the number of drops needed to turn the solution colorless and vitamin C?
2. Which type of juice had the most vitamin C? The least? How do you know?
3. Why is vitamin C important to our bodies?
4. What is the difference between water-soluble and fat-soluble vitamins?
5. Why must we replace vitamin C daily?

Extension

1. Research to find out the recommended daily value of vitamin C you should have in your diet. Plan a menu for one day that would allow you to get the recommended daily value of vitamin C you need to stay healthy. Find out about other antioxidants. Be sure to include these foods in your menu plan as well.
2. Compose a song or write a poem about the importance of vitamins and antioxidants. Share your song or poem with the class.
3. Obtain a vitamin C tablet or lozenge. Using the fact label, record the number of milligrams of vitamin C in the tablet. Dissolve the vitamin C tablet in 30 mL of water. Test the liquid by using the cornstarch-iodine solution. Using your results as a control, determine a way to estimate the amount of vitamin C found in the fruit juices you tested. Compare your findings with the nutrition labels on the package.

VITAMIN C DATA CHART

Type of Juice	Number of Drops of Juice Added to the Indicator Solution

Rate That Snack

Purpose

- To identify the function of vitamins and minerals to a healthy body
- To plan a nutritionally balanced snack
- To design a realistic nutrition label for a snack food

Background

Vitamins are small molecules that the body needs to function properly. The body requires various vitamins. Children's bodies rely on the foods they eat to provide these vitamins, which are necessary for growth and development. Each vitamin has a different function in the body.

Minerals are also important to maintain a healthy body. Minerals, like vitamins, help the body grow, develop, and stay healthy. Minerals fall into two categories: macrominerals and trace elements, or microminerals. Macrominerals are minerals that the body needs in large amounts (100 mg/day or more). Trace elements are minerals that the body needs in small amounts to stay healthy.

Many people understand the importance of eating healthy meals for breakfast, lunch, and dinner, but they often forget to plan healthy snacks between meals. Snacks are especially important for growing children. Due to their smaller stomachs, children cannot take in enough food to provide adequate daily nutrition in just three meals. Snacks between meals can help satisfy a child's daily nutrition requirements when healthy foods are chosen.

Snacks should be planned as part of the day's food plan and eaten at regular times during the day. Also, snacks should only be eaten when you are hungry, not because you are bored or upset. Healthy snacks such as raw vegetables, fresh fruit, low-fat yogurt, low-fat cheese with whole-grain crackers, popcorn, and nuts are healthy alternatives to less nutritious snacks such as cookies and candy bars. If less nutritious foods are used for snacks frequently, they can adversely affect your health. It is very important to make healthy snack choices to keep your body healthy.

For most foods, nutrition facts can be found on the nutrition label on the outside of the food package. Labels include information about serving size, calories, fat, cholesterol, and percentage of daily values for certain nutrients, including vitamins and minerals. Recommended daily values (DV) are the amounts experts have decided are necessary to maintain good health. Because these daily values are based on a 2000 calorie diet, your diet values may be higher or lower depending on your personal calorie needs.

Packaging of certain foods can be deceiving. Just because the packaging on your snack food is fun and interesting does not mean that the food is necessarily a healthy choice. Likewise, packaging that appears dull and boring does not mean that food will not taste good. Do not judge a food by its packaging. Read the nutrition label so you can evaluate how healthy the snack food really is and be able to make wise food choices.

Teacher Prep

Request that students bring a sample of one or two snacks that they eat most often.

Procedure

1. Conduct research on the Internet or at the library to learn more about the vitamins and minerals your body needs.
2. Create a chart to show the most important vitamins and minerals and the recommended daily allowance for each.
3. Include a column to list the main purpose of that vitamin or mineral.
4. Using the Snack Questionnaire, keep a log of all snack foods you eat in a week.

Materials

Snack Questionnaire
(p. 56)
snack food items
art paper (various colors)
pen or pencil
science journal
computer with Internet
access
library access

Rate That Snack

Segment 2

- Examine the food labels for each snack. Note: If you made the snack, you may need to do some research to learn about its ingredients.
- Use the key on the questionnaire to rate each snack by using a number from 1 to 4, with 4 being a very healthy snack.
- Have a partner become your “expert nutritionist.”
- The expert nutritionist should evaluate your snacking habits and give you advice on how to improve your snack choices to help keep your body healthy.
- Make a list of the reasons you snack. If you snack for reasons other than hunger, brainstorm with your nutrition expert for ways to find other activities to do instead of snacking.
- Work with your nutrition expert to create a healthy snack.
- In your science journal, describe the snack and list all ingredients.
- Conduct research to find the nutritional content of the ingredients in your snack.
- Make a nutrition label for your snack. Be sure to identify the vitamins and minerals that the snack contains and list the fats and sugar content.
- Using art paper, create the packaging and nutrition label for your snack item.
- Remember to make the packaging fun and interesting enough to grab the shoppers’ attention.
- Share your new idea of a snack food with your class and explain why it is nutritious, or healthy, and why they should eat it.

Discussion

- Why are vitamins and minerals important to the body?
- What kinds of foods could you eat to add more vitamins and minerals to your diet?
- If you are eating healthy meals, why is it important to eat healthy snacks?
- What unhealthy snack habits might you need to change?
- Make a list of healthy snacks for you and your family.

Extension

Using the library and Internet, research the various vitamins and minerals your body needs. Create an A to Z book to show the necessary vitamins and minerals your body needs. Be sure to include why each vitamin and mineral is important and what foods are the best sources for each.

Refried Beans Fat Free

Nutrition Facts

Serving Size 1/2 cup (125g)

Serving Per Container 3.5

Amount Per Serving

Calories 130 Calories from Fat 0

% Daily Value*

Total Fat 0g **0%**

Saturated Fat 0g **0%**

Trans Fat 0g

Cholesterol 0mg **0%**

Sodium 490mg **20%**

Total Carbohydrate 24g **8%**

Dietary Fiber 7g **28%**

Sugars 0g

Protein 9g **16%**

Vitamin A **0%**

Vitamin C **0%**

Calcium **6%**

Iron **15%**

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories:	2,000	2,500
Total Fat	Less than	65g	80g	
Sat Fat	Less than	20g	25g	
Cholesterol	Less than	300mg	300mg	
Sodium	Less than	2,400mg	2,400mg	
Total Carbohydrate		300g	375g	
Dietary Fiber		25g	30g	

SAMPLE NUTRITION LABEL

Rate That Snack

Segment 2

Snack Questionnaire

Snack Food	Where You Ate It	Why You Ate It	Vitamins and Minerals	Sugar Content	Calcium Content	Fat Content	Snack Rating *

Snack ratings:

- 4 – a very healthy snack; low in sugar; low in fat; high in one or more vitamins or minerals
- 3 – a healthy snack; low to medium in sugar, but high in vitamins or minerals
- 2 – a somewhat healthy snack; low in sugar, but may be high in fat; has only small amounts of recommended vitamins or minerals
- 1 – unhealthy snack; high in sugar and fat; has little nutritional value

Answer Key

Segment 2

Putting on the Bone

1. The clay person without bones will fall over and bend in half. It is unable to stand upright or maintain its shape. The clay person with bones will be able to stand upright on its own, maintaining its shape.
2. The skeleton gives the body support, shape, and protection but is also light enough to make movement easy.
3. The cup filled with the beans held the most weight. Answers will vary, but students should understand that a mostly solid cylinder is able to hold more weight than a hollow cylinder.
4. The cup filled with the beans is most like our bones. The cup represents the hard outer walls. The beans are similar to the hard, spongy layer filled with tiny holes found inside our bones.
5. Although the outside structure of the bone is similar to our bones, the inside of the chicken bones (and other bird bones) is hollow, making the bird lighter. This configuration is an important adaptation to allow flight.

Hole-y Bones

1. Calcium is important to build and maintain strong bones and teeth.
2. As bone mass is lost, the bones weaken and become fragile, making fractures more likely.
3. Answers will vary by age: the adult recommended daily allowance (RDA) is 1200 mg; children's RDA is 800 mg.
4. To prevent bone mass loss, you should get the recommended daily amount of calcium, preferably by eating calcium-rich foods and by being physically active to help strengthen bones.

Bendy Bones

1. The bone left in the water (the control bone) was the strongest. The bone that had been soaking in the vinegar for the longest amount of time was the weakest. You could determine the strength of the bone by whether or not the bone would bend.
2. Vinegar, an acid, slowly dissolves the calcium in the bones, making them weak.
3. The bone weakens and becomes flexible. The bones left in the vinegar continued to get weaker so the angle at which you could bend them increased.
4. Long-term effects of calcium loss can include an increased chance of broken bones, unhealthy teeth and gums, and rickets.

Counting the Calcium

1. Calcium is necessary to build strong bones and teeth, regulate the heartbeat, clot the blood, maintain proper thyroid function, and help transmit nerve impulses.
2. Some common calcium-rich foods include broccoli, beans, and dairy products, such as milk, cheese, and yogurt.
3. Vitamin D helps the body absorb the calcium that is consumed.
4. We can get vitamin D from fortified foods, but most of it is made in our skin when we are exposed to sunlight.
5. Eating calcium-rich foods is the best way to add calcium to our diets.

Oh, Say Can You C?

1. The fewer drops needed to turn the solution colorless, the greater the amount of vitamin C.
2. Answers will vary depending on type of juice tested. The juice that required the least number of drops of the iodine solution to turn the solution colorless will contain the most vitamin C.
3. Vitamin C is needed to keep body tissues in good shape and to help the body heal from injuries and infections.
4. Water soluble vitamins are not stored in the body and must be replaced often, whereas fat-soluble vitamins are stored for as long as six months in the fat tissues of the body until they are needed. .
5. Vitamin C is water-soluble and is depleted throughout the day. Therefore it must be replaced daily.

Rate That Snack

1. Vitamins and minerals help the body grow, develop, and stay healthy.
2. Answers will vary, but should include fruits, vegetables, and low sugar snacks.
3. Most common snack foods are high in fats, sugar, and sodium and may replace nutritious snacks that are better for a healthy body.
4. Answers will vary, but students should identify unhealthy snacks.
5. Answers will vary, but healthy lists should include such snacks as raw vegetables, fresh fruit, low fat-yogurt, popcorn, or nuts.

On the Web

Being on the Inside

1. The paper towel with the most folds absorbs the most water because the folds give the towel more surface area that comes in direct contact with the water.
2. The inner surface of the small intestine is ridged, not smooth, giving the inside of the tube more surface area to absorb large quantities of liquid nutrients.
3. If the lining of the small intestine were smooth, many of the liquid nutrients would not be absorbed and would simply pass through the digestive system, unusable by the body.
4. The water in cup A is yellow-orange because the iodine has been added.
5. The water in cup B turned blue-black because iodine changes color in the presence of starch.
6. The water inside the plastic bag also turned blue-black after about 30 minutes because the iodine molecules are small enough to pass through the plastic bag and react with the starch inside.
7. During digestion, the vitamins and minerals from food break down into liquid nutrients and are then absorbed through the lining of the small intestine. The cell membranes allow some nutrients to pass through, but they prevent waste from entering the cell. The folds in the paper towel are similar to the lining of the small intestine. The folds provide more surface area, allowing the body to absorb more of the liquid nutrients. These nutrients then pass through the cell membrane like the iodine solution passed through the plastic bag.